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Fossil Beds Paleontologist Earns Scientist of the Year Award

Article courtesy of David Carkhuff, Blue Mountain Eagle

DAYVILLE, Ore. — The Pacific West Region of the National Park Service has awarded local John Day paleontologist, Ted Fremd, the "Research Scientist of the Year."

This award was created to reward excellence in developing scientific programs or published research which further the cause of science or natural resource management in the service. In addition to his duties as a paleontologist, Fremd is one of a handful of Science Advisors in the NPS, providing input to research programs in 66 very diverse national parks such as Olympic, Yosemite, and Petrified Forest.

John Day Fossil Beds National Monument Superintendent Jim Hammett prepared the nomination, in which he stated, "Ted, virtually by himself, built one of the most respected and complete field-based paleontological research programs in the United States. He has published extensively and focused his and our partner's research on the most compelling questions of John Day's ancient past.

"His conclusions regarding the best and most efficient methods for furthering paleontological understanding and research formed the basis for the function, size, scale, and focus of the new $8.4 million Thomas Condon Paleontological Center currently under construction at John Day. It is scheduled to open to the public and researchers in 2004. Our goal is to make Ted's research program as transparent as possible to visitors and convey to them the importance and relevance of such research.

"One of the most important aspects of the paleo resources of the John Day Basin is its long uninterrupted fossil sequence and the unique attribute of being mostly comprised of very datable volcaniclastics. Few fossil localities preserve much more than a million years in time, yet the John Day localities preserve an uninterrupted sequence of about 50 million years. This makes the John Day Basin a valuable temporal benchmark for fossils found all over the globe — particularly those that are in matrix that cannot be easily dated."

Frequent readers of the Blue Mountain Eagle may recall Fremd's articles the last few years about the John Day region, "The Fossil Record." He has offered to continue the series later this spring, focusing on new scientific information about the "strange and wonderful" creatures and plants of the past, and the rocks they are entombed in, that will be featured in the Paleontology Center.

Ted Fremd in the field at John Day Fossil Beds National Monument

Fremd said, "It's easy to get enthusiastic about a place as globally important to scientists as the John Day, and even easier when you work with a staff like we have here. The first superintendent of the park, Ben Ladd, strongly encouraged active science, and Jim Hammett has continued that emphasis. Few people realize that we have such a great team, including one of the best fossil preparators in the country, a superb collection manager, great volunteers, and I've just hired a new paleobotanist to round out our expertise. I think anybody would excel working with people like this in geological surroundings as stunning as can be found in this part of Oregon."

To learn more about the paleontology and research at John Day Fossil Beds National Monument you can visit their website at:
http://www.nps.gov/joda/paleo.htm

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The Tree Molds at Pu'uhonua o Honaunau: A record of loulu palms on the Kona coast

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Tree molds form when sediments or lava bury or surround a tree and preserve its form. They are found in a variety of geologic settings. In Hawai'i, conditions are optimal for the formation of tree molds when flowing lava – usually of the more fluidic pahoehoe type - moves though a forested area (Walker 1995). As hot lava engulfs a living tree, steam escaping from the tree keeps it from burning long enough to be impressed into the lava. The surrounding lava, which has been described as "a sheath of quenched basalt" (Lockwood and Williams, 1978), often preserves the surface details of the tree even after the organic matter has burned or rotted away.

Tree molds are valuable scientifically for a variety of reasons. The shape and orientation of the molds can be used to establish locations of vents and direction and force of the flow (Lockwood and Williams, 1978; Froggatt et al., 1981; Giannetti, 1996). The charred wood that can sometimes be recovered from the molds provides information about flow temperatures (Lockwood and Lipman, 1980), vegetation present at the time of the eruption, and also the age of the flow if the material can be radiocarbon dated.

Identification of taxa based on the surface characteristics of the molds is sometimes possible. The lower vascular plants of the Paleozoic coal forests, for instance, had scale-like leaf attachments that formed characteristic patterns on the surface. More recent molds are generally more difficult to identify, unless wood or charcoal can be recovered. The molds at Pu'uhonua are an exception, their identification is made possible through a fortunate combination of circumstances.

Research crew with fragmented tree mold at Pu'uhonua o Honaunau.

Description of the Molds

Tree molds are numerous in the volcanic terrain of the Big Island of Hawai'i, where the processes that formed the islands still send lava down the flanks of the volcanoes toward the sea. Pu'uhonua o Honaunau National Historical Park lies along the Kona coast on the southwestern slope of Kilauea volcano. The molds we studied are along the coastline near an ancient Hawaiian fishing shrine, on the surface of a flow approximately 1,100 years old (radiocarbon date of 1,111 ± 51 years BP) and is attributable to combustion of organic material (Lockwood and Lipman 1980).

A common feature of the molds is lava infilling, a phenomenon in which molten material has been forced up through the solidifying surface of the flow through a fracture or weak spot, in this case the impression of the mold on the surface. These features are called "squeeze ups" and also "toothpaste lava" since they look like a line of toothpaste (Fig. 1). The many molds extending horizonally across the flow represent trees that fell into the lava and were carried along with the flow. The majority of the horizontal molds are unbranched, but some show distinctive branching. In some cases, the lava moved around still standing trees, producing vertical molds.

Our field study included measuring dimensions of the molds and making descriptions of the surface features and patternings. Diameter (or estimated diameter) of the horizontal unbranched molds averages 11-21 cm and does not vary much along the length. Median length of these molds is ~3 m. The longest mold has a length of 10.5 m and is considerably wider at one end, which probably represents the base of the tree. The vertical molds also include larger-diameter specimens (25 and 37 cm).

The unbranched molds are straight-sided but have a characteristic surface texture. Walker (1995) described the surface of some Hawaiian tree molds as a "boxworks" of basalt septa and attributed the pattern to basalt infilling in cracks of charred wood. The

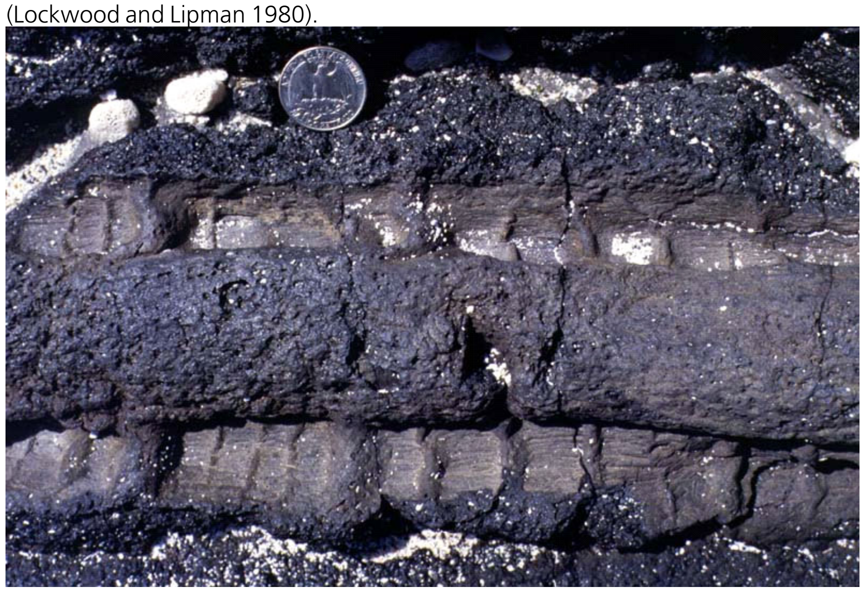

Fig. 1. Unbranched tree mold with squeeze-up in center

Fig. 2. Tree mold showing longitudinal and radial septa.

description is apt – the Pu'uhonua molds show a regular pattern of rectangular basalt septa much like a boxworks – but we doubt that all the specimens found in the park were necessarily charred at the time the molds formed. The surface in most cases has pronounced longitudinal septa that are 2-7 mm wide and relatively continuous along the length of the mold. Oriented perpendicularly are radial septa that are both less pronounced and less continuous. Together the septa form a rectangular pattern (Fig. 2). Width and spacing of the septa vary from specimen to specimen and also often along the length of the mold. The variations observed may be influenced by pressure with which the molten lava forced itself into fissures in the tree or the degree to which trees cracked when coming in contact with hot lava. A few of the unbranched molds (and all of the branched molds) do have a pattern suggesting charring, with wide septa that form large, fairly uniform rectangles.

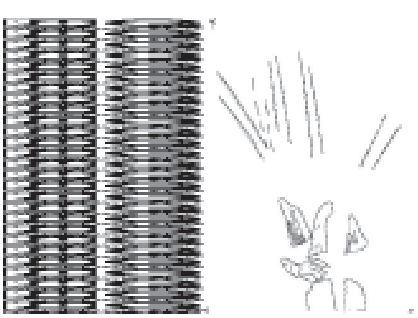

Fig. 3. Drawing showing the pattern of leaf bases and petioles.

Identifications

There are a variety of indications that the unbranched molds are loulu (*Pritchardia*) palms, a genus including many species endemic to the Hawaiian Islands. The palmlike habit is best illustrated by a mold that preserves the impressions of leaf bases and petioles (Fig. 3). Impressions appearing to be the broad portion of the palm leaf base part on morphological characters including a generally columnar form, can also be seen at several locations. Identification as *Pritchardia* is based in based in part on morphological characters including a generally columnar form, although often with a flared base in older individuals, and sides that are straight and without pronounced leaf scars, persistent leaf bases, or other notable features (Fig. 4). There is also a generalized correspondence between the septa visible on the molds and the surface patternings of living *Pritchardia* palms, which have prominent longitudinal furrows that are relatively continuous along the length of the tree and shorter less well-developed radial furrows. The coconut palm (*Cocos*), by way of comparison, has a surface that is rougher, with less continuous longitudinal furrows and more evident leaf scars; is normally larger in diameter; and typically grows in a curved or slanting fashion rather than being straight-columnar.

The genus *Pritchardia* includes several species with diameters approximating that of the molds. The most likely candidate is *Prichardia affinis* Becc., a coastal species known to have been widespread in leeward areas of the island in former times (Hodel, 1980). Pollen and macrofossil records from lowland areas of O'ahu and Kauai show a clear correspondence between human occupation and subsequent decline of *Pritchardia* (Fig. 5); (Athens, 1997; Burney et al., 2001). The Pu'uhonua molds are an additional source of information about the rise and fall of coastal palm communities. Our study also suggests that tree molds may be an underutilized source of information about paleoecology and the chronology of landscape change in Hawai'i.

Management Considerations

The tree molds at Pu'uhonua o Honaunau are an easily viewed aspect of the site's natural history that are interesting both collectively and

Fig. 4. Loulu palm near the park office. Diameter is ~12 cm at breast height.

Did You Know?

Tree molds in lava flows are also preserved at Craters of the Moon in Idaho, El Malpais in New Mexico and Lava Beds National Monument in California. Some of the parks have hiking trails to the tree molds. Besides tree molds that formed around longs on the ground some of the molds were formed when the lava flowed around upright trees. These upright tree molds range from a few inches to just under 3 feet in diameter.

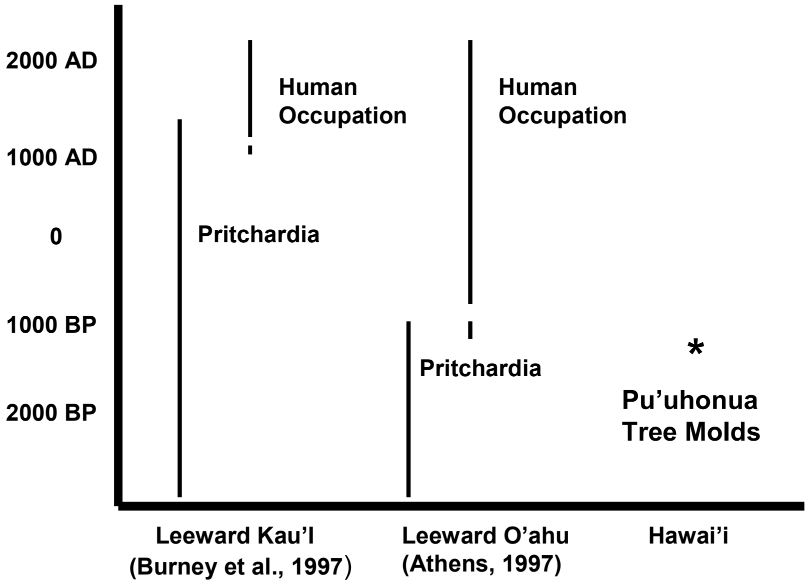

Fig. 5. Correspondence between human occupation and *Pritchardia* occurrence.

individually. Particularly notable are the specimen with leaf bases evident at the apex; specimens showing "squeeze-ups" where lava has breached the mold from below; the longest mold with its flared base; the vertical molds which display a septum on one side showing how the lava flowed around the tree on its path toward the ocean; and the branched molds with their completely different morphology. Fortunately, the tree molds are not an especially fragile resource and unlikely to be damaged by normal foot traffic. Thus there is no reason that visitors could not be encouraged to view the tree molds at close hand since they have much to say about the dynamics of lava flows, the process of tree mold formation, and vegetation and landscape change in Hawai'i.

Pu'uhonua is one of the most historically significant and beautiful sites in the islands. Standing on the lava flows along the coastline, with the broad slopes of Kilauea rising to one side and the great stone walls of the refuge and the other archeological features as backdrop, is an experience not to be forgotten. It also rather remarkable to find at one's feet the impressions of native palms that once thrived in this coastal area now dominated by introduced plants.

Acknowledgments
We appreciate the assistance of Satomi Maekawa, Ali Hosseini, and the staff at the Park.

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What is Basalt?

Basalt is a fine-grained dark-colored igneous rock. More popularly known as "lava", to a geologist, basalt is defined by its minerals and a low silica content. Basalt melts at a temperature of about 1200 degrees centigrade. When it erupts as lava it is very fluid and can spread out thin into flows to cover large areas. When a basalt flow on the surface is slow-moving, rough and with a clinkery surface it is called aa (pronounced ah-ah) while the more fluid and faster moving basalt that has a smooth and ropey surface is called pahoehoe (pronounced pay-hoy-hoy). Tree molds are usually found in pahoehoe lava.

Many parks have basalt lava flows including Hawaii Volcanoes, El Malpais, Craters of the Moon, Lava Beds, Devils Postpile and Lake Roosevelt.

New Paleobotantist at John Day Fossils Beds National Monument

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Regan Dunn has recently been hired as the first staff paleobotanist at John Day Fossil Beds National Monument.

She is a native Coloradoan who practically grew up on fossil leaf sites in the Denver Basin, but it took her 25 years to find them. She graduated from Colorado State University in 1995 with a B.S. in Biological Sciences with a concentration in cellular and molecular biology, and a minor in Anthropology. After working in various molecular biology labs, she became tired of a life indoors at the lab bench, and she set out for a life of seasonal employment as a river guide and ski instructor. By 1998, seasonal employment had become uninteresting for Regan, and she enlisted to work on a drill rig contracted by a team of stratigraphers, paleontologists, and hydrogeologists from the Denver Museum of Nature and Science. After describing hundreds of feet of core and working at several fossil leaf sites in the Denver Basin, Regan's career choice was made.

She is now in the process of completing graduate school at the University of Wyoming where she has been studying Paleocene floras (both leaf fossils and palynomorphs) from the Hanna Basin, Wyoming. Concurrent to working on her degree in Wyoming, she continues working on most unusual fossil floras from the early Paleocene in the Denver Basin, including coauthoring a major new paper on the Castle Rock Rainforest. Her research interests include correlating fossil plant assemblages, leaf fossils and palynomorphs, with other age-models including mammalian and pollen biostratigraphy, and radioisotopically dated rocks.

"The paleobotanist position at John Day Fossil Beds is an ideal fit for me, and I greatly look forward to many fruitful years of research and resource protection with the John Day paleontology team," she said.

Ted Fremd, the park's senior paleontologist, commented that she was very highly recommended by some of the world's leading paleobotanists, making his selection of candidates from around North America easier. "A lot of people think that most paleobotanists are either nuts or very seedy characters," he said. He adds that for folks interested in the fossil plants, which have not received as much research attention as the animals, "Yew won't have to pine as she will spruce up the plant collections fir a change."

Additional Reading

Wheeler, E.A. and S.R. Manchester. 2002. Woods of the Eocene Nut Beds Flora, Clarno Formation, Oregon, USA. International Association of Wood Anatomists Journal, Supplement 3: 188 pp.

Regan Dunn, new paleobotanist at John Day Fossil Beds National Monument.

Alnus **(alder) fruit from John Day Fossil Beds National Monument**

Fossil Plants at John Day Fossil Beds

Established in 1974, John Day Fossil Beds Oregon is composed of three managment units - Clarno, Painted Hills and Sheep Rock. The geology of the monument includes four major rock formations that preserve a diverse flora and fauna that range in time from the Eocene to the early Pliocene (50 to 6 million years ago).

The oldest formation, the Clarno, is Eocene in age and preserves fossil seeds, nuts, fruits, leaves, branches and roots of plants that lived in a tropical to subtropical forest. These are known as the Clarno Nut Beds and hundreds of species of plants have been found.

The late Oligocene and early Miocene John Day Formation preserves evidence of early deciduous forests.

The Mascall Formation is late Miocene in age and preserves evidence of some of the early grasses. Mixed hardwood forests similar to those found in the eastern United States today are also present.

Fossil plants from the early Pliocene Rattlesnake Formation indicate a cooler and dryer climate dominated by grasslands.

New Book on the Fossils of Florissant Fossil Beds

The Smithsonian Institution Press has just published a new book on the “The Fossils of Florissant” written by Herb Meyer, paleobotantist at Florissant Fossil Beds National Monument. The book is the culmination of over seven years of research that Meyer started with a survey of museum collections with Florissant fossils in 1995. The book proposal was submitted Smithsonian Press’ chief editor in 2000. The result “The Fossils of Florissant” is the definitive work regarding all the fossils that have been excavated from the Florissant Formation over the last 130 years and covers the entire flora and fauna of Florissant, plants, insects, and vertebrates. Today these fossils are found in collections and museums throughout the world. The “Fossils of Florissant” is available at the visitor center bookstore at Florissant Fossils Beds National Monument or can be ordered directly from Smithsonian Institution press. See Recent Literature on Park Paleontology on page 7.

The first record of fossils in the area was in 1871 when the Daily Central City Register that reported that Florissant had “a petrified forest near which are found, between sedimentary layers, most beautiful imprints of leaves differing entirely from any that grow in the valley now-a-days.” The first scientific paper describing the fossils from Florissant was written in 1876 by Samuel H. Scudder and continued research in the area has resulted in 3756 different kinds of plants and animals being recorded from the Florissant Lake Beds.

The project involved 42 trips and he spent 9 months on the road visiting collections and looked at 5500 specimens of which more than 90% of which are previously published as types or otherwise referenced specimens. The database he compiled includes about 300 other specimens that are in publications but did NOT show up in the collections. He took more than 6,000 Kodachrome images, all in duplicate for a total of more than 12,000 slides. The book includes type and published material from Florissant

Herb Meyer, paleobotanist at Florissant Fossil Beds National Monument, turning over a new (old) leaf.

housed in 14 museums, many of which are illustrated for the first time.

To illustrate the importance of the Florissant area for its fossil record some of the numbers include:

Total number of specimens originally described as a Holotype: 1549

Number of total specimens from Florissant in current literature as Holotype: 1401

Number of plants originally described as Holotype: 219

Number of plants in current literature as Holotype: 105

Number of insects originally described as Holotype: 1272

Number of insects in current literature as Holotype: 1239

Different funding sources covered different parts of the project. CRPP paid for most of the on-site museum visits to inventory collections. NRPP paid for much of the database and website development, and for the project to “update taxonomy.” CDP (Colorado Digitization Project) paid for scanning many of the digital images (including of publications) for the database. GRD paid for some of the extra help at Harvard (an additional 3 months was spent by one of the lab instructors at Harvard who assisted with the huge MCZ collection). A grant from Canon paid for some of the interns to enter data into the database. FLFO base budget paid for his salary during the project.

Meyer gratefully acknowledges the help of the many contributors to the book and the related database and website project including his interns, Matt Wasson, intern/seasonal tech, helped with refining database for web conversion, April Kinchloe and Amanda Cook intern/seasonal techs who helped with database entries, Dr. Boyce Drummond, entomologist/consultant, who evaluated higher taxonomic ranking for the insects, John Fraser, helped with collection inventory at Harvard and Linda Lutz-Ryan, environmental education at FLFO, who contributed original artwork used in four figures in the book.

Besides the book, the information about the fossils from Florissant housed in different museums visited by Meyer during his visits has been compiled into a database that is accesssible via the internet at:
http://planning.nps.gov/flfo

Anyone interested in learning more about the plants, insects or any other fossils found at Florissant can go to this one line database and search it for more information about the paleontology and geology of the monument.

What is a holotype?

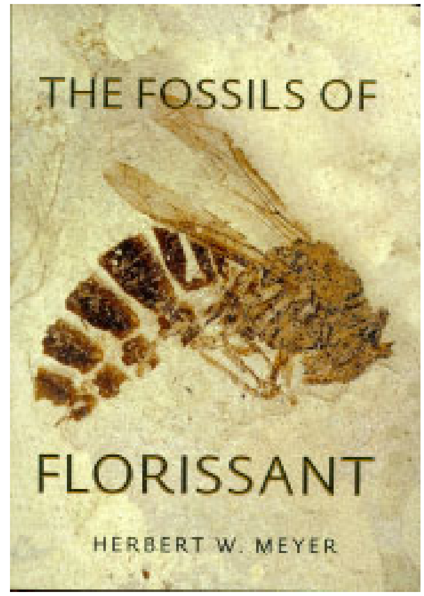
A type specimen, also known as the holotype, is the specimen upon which a new species of plant or animal is based. It serves as the primary reference specimen that allows paleontologists, zoologists and botanists to confirm that other newly discovered species are the same or different from species already described.

Recent Literature on Park Paleontology Resources

THE FOSSILS OF FLORISSANT

Herbert W. Meyer

In the rocks of Florissant, Colorado, lying in the shadow of Pikes Peak, is the evidence of a long-lost world. Encased by the ash of volcanoes that erupted tens of millions of years ago, animals such as insects, fish, and mammals were fossilized in the same deposits as flowers, trees, and the delicate leaves of plants. This amazing collection of animals and plants from the same place at the same time provides a rare, uniquely comprehensive glimpse of life in the past. Through more than 200 color photographs and vivid descriptions of the fossils, Meyer brings the fossils of Florissant to life, not only providing background on the plants and animals, but also exploring the warm environment in which they lived. The site was once a treasure trove for paleontologists who acquired the fossils for museums around the world; it is now protected as Florissant Fossil Beds National Monument. Meyer's book reveals the beauty of both the site and its delicate fossils, and offers a compelling story of life long ago.



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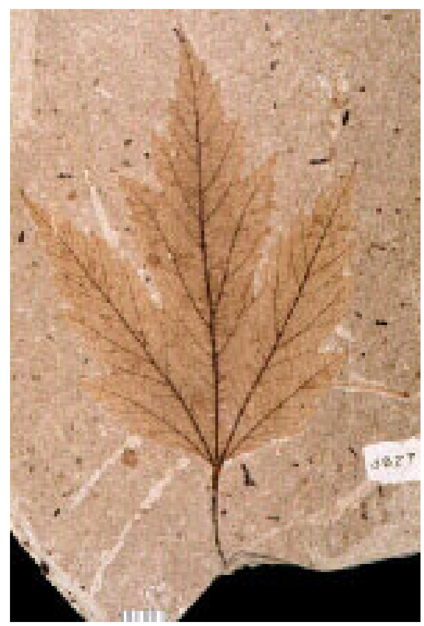
Damelsfly, *Miopodagrion optimum*, from Florissant Fossil Beds. Courtesy of the University of Colorado Museum.



Leaf of an early maple, *Acer florissantii*, from Florissant Fossil Beds. Photo courtesy of the University of California Museum of Paleontology.

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Example of the types of fossil plant material preserved in the Clarno Nut Beds at John Day Fossil Beds National Monument.